DOCUMENT RESUME

ED 222 887 CS 006 899

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TITLE Illustration-Dependence as a Factor in Transfer of Prose Learning.
PUB DATE Mar 82
NOTE 17p.; Paper presented at the Annual Meeting of the American Educational Research Association (New York, NY, March 19-23, 1982).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Grade 7; *Illustrations; Junior High Schools; Junior High School Students; *Reading Comprehension; Reading Habits; *Reading Improvement; *Reading Research; *Transfer of Training; *Visual Stimuli
IDENTIFIERS *Illustration Dependence; Prose Learning

ABSTRACT

To determine the relative transfer value of imposed and induced visual images in relation to level of textual materials' illustration-dependence, 108 seventh grade students read textbook excerpts written at four levels of illustration dependence under four visual imagery conditions. The four levels of illustration dependence were high, moderate, low, and none. The four visual imagery conditions were no illustrations/no instructions, illustrations/no instructions, illustrations/with instructions to view them, and no illustrations/with instructions to visualize text content. In a Latin square design, experimental materials were rotated across treatment groups so as to counterbalance levels of illustration dependence and visual imagery conditions. The interactions between treatment conditions and level of illustration dependence suggest that subjects given texts whose illustration dependence was moderate to high benefited from the presence of illustrations. Although instructions to attend to text illustrations did appear to somewhat enhance performance on transfer tasks, improvement in performance was not significantly improved by such instruction, except in the case of the most illustration dependent text. The data indicate that provision of illustrations enhances learning from text, but it does so to the extent that the text is illustration dependent. (HOD)

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Illustration-Dependence as a Factor in Transfer of Prose Learning

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Paper Presented at the Annual Meeting
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New York City, March 21, 1982

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Research on visual aids to prose learning suggests that visual aids adjunct to prose material can increase comprehension and learning, although conclusions drawn from that research remain tentative (Rigney and Lutz, 1974; Readence and Moore, 1981). In the area of textually presented aids, positive effects stemming from the use of visual materials by themselves have been shown to be associated with type of visual materials (Dutton, 1978) and type of cues given (Kauchak, Eggen, Kirk, 1978). However, the research on illustrated prose material has shown little effect due to illustrations on the learning of that material when the material is read by the subjects (Readence and Moore, 1981). In the area of reader-generated imagery, some positive effects have been found, especially insofar as it may prove helpful for coping with poorly organized text (Levin, 1973). The magnitude of effects due to reader generated imagery, however, seems to be related to both subject and text characteristics. The ability to create a visual image while reading may be influenced by chronological or mental age (Pressley, 1976), by ability to comprehend the text (Levin, 1973), and by ability to learn from illustrations (Levin, et al. 1974).

For the most part, investigations on visual aids to prose learning suffer from generality of purpose and artificiality in procedure. Typically, they pose very broad questions about the effectiveness of texts' illustrations; yet, just as typically they fail to inquire into possible circumstances under which illustrations might prove helpful. Few studies have been undertaken with school-age children who actually read the experimental materials for themselves, rather than listen to them and which used materials representative of traditional school texts rather than programmed materials, filmstrips, or cartoons. Given the

limitations of the previous research on visual aids to reading, the widely accepted conclusion among many researchers (such as Concannon, 1975; Samuels, 1970; Vernon, 1953) that illustrations in text do not facilitate comprehension hardly seems warranted, especially when a conclusion runs contrary to our intuitions about the clarifying power of illustrations.

Research by Haring and Fry (1979), Hayes and Readence (1981), Holliday (1974, Koenke and Otto (1969), Rasco, Tennyson, and Boutwell (1975) and Thomas (1978) suggests that rather than merely investigating whether illustrations in texts are generally helpful, researchers should refine their questions to focus on the effects of illustrations in relation to text characteristics and the circumstances under which texts are read. The present investigation was undertaken to learn whether content is related to illustrations' transfer effect under variant instructional conditions.

Method

Subjects were 108 seventh grade students from a middle school in western North Carolina. Subjects were average or better readers. For the study, subjects were assigned at random to four treatment groups.

Materials were prose passages excerpted from texts intended for instructional use with middle grade students. The materials were passages whose level of illustration-dependence for communicating their content had previously been empirically determined with other seventh grade students. The texts had been screened for inclusion in the experiment according to criteria which Schallert (1980) suggests contribute to textual illustrations communicative value, namely that: (1) the text be easily decoded, (2) information in the illustrations be central

to the text, (3) the illustrations provide a different access to the text content, (4) the illustrations be congruent with the text content, and (5) the illustrations provide a spatial or schematic representation of the interrelations of the text content. Thus screened, the texts for this study had been selected and differentiated on their level of dependence on illustrations according to 24 seventh grade students' relative success on multiple-choice tests on the texts, with and without illustrations present. One text (on finger computation) was judged to be highly illustration-dependent. A second text (on topographic maps) was judged to be moderately illustration-dependent. A third text (on the eyes) was judged to be slightly dependent. A fourth text (on volcanoes) was judged not to be illustration-dependent. Each text contained approximately 300 words. Additional 100-word texts which incorporated the concepts illustrated in each of these texts were selected to serve as transfer passages. These texts were assembled into packets so as to provide four different sequences distributed comparably across all four treatment conditions, which are described below.

Design. The experiment was designed to counterbalance four levels of illustration dependent texts under four treatment conditions. Data were collected on a single occasion within a Latin square repeated measurement design with one within-subjects variable (treatment) and one between-subjects variable (illustration-dependence). Given four different text sequences, subjects read and responded to a different textbook excerpt and its transfer passage during each of four treatment phases. The text sequences provided for a rotation of texts upon each successive treatment phase so that during the experiment each of the

four groups was exposed only once to the four textbook excerpts and their accompanying transfer passages.

Under the first treatment condition the subjects read a text without illustrations and without any instructions other than to recall in writing as much as possible of the transfer passage.

After all subjects completed this task, they were given the task of the second treatment condition, which was like the first condition except this time the texts were augmented by illustrations. The illustrations were line drawings which depicted the text content. No instructions were given to look at these drawings, only to recall as much as possible of the accompanying transfer passage.

For the third treatment, subjects turned to their packets' third text which, was also augmented by line drawings. Again the subjects were told to read the text and then to read and recall the accompanying transfer passage, but this time they were told that the pictures should help them understand the material and advised that they should therefore pay careful attention to the pictures.

For the fourth treatment, the subjects turned to the last text in their packets. This text had no illustrations, as in the first treatment condition. This time, however, subjects were instructed to try to imagine their own pictures to go along with the materials.

Analysis

In order to provide a model against which to compare subjects' recall protocols, a template text base was prepared for each transfer passage according to procedures detailed by Turner and Greene (1977). Each protocol text base was scored by comparing it to its corresponding

template text base for degree of similarity of recalls to the transfer passages. Propositions of each protocol text base were compared to those of the template text base and identified as representing either text-based information or reader-based inferences drawn from the transfer passages (an example is presented in Figure 1). Interscorer reliability exceeded .94 in proportion of agreement.

Results and Discussion

The treatment conditions across four levels of illustration-dependence were compared by an analysis of variance for mixed design with one between-subjects variable and one within-subjects variable. The results are summarized in Tables 1 and 2. Interactions are depicted in Figures 2 and 3.

Statistically significant interactions between treatment condition and level of illlustration-dependence were observed on both the overall number of propositions, $F(9, 312) = 3.65$, $p < .01$ and the proportion of reader-based inferences, $F(9, 312) = 3.01$, $p < .01$. With respect to overall number of propositions generated in recall, Tukey HSD post hoc tests revealed an interaction between the high illustration-dependent texts and both illustration conditions and an interaction between the moderately illustration-dependent text and the illustration condition directing subjects' attention to the illustrations. With respect to the proportion of reader-based inferences relative to overall recall, an interaction was again noted for the highly illustration-dependent text and both illustration conditions, and between the latter a significant difference in favor of directing subjects attention to the illustrations.

No main effects for text were observed in the overall recall data. In the proportion of inferential information given in recall, a main effect for text was observed, $F(3, 104) = 2.95$, $p < .05$, reflecting a significantly low proportion of reader-based information given in the recall of the low illustration-dependent text.

Main effects for treatment condition were observed in overall recall, $F(3, 312) = 14.54$, $p < .001$. Each of the two illustration conditions elicited greater recall than either of the two non-illustration conditions. Between the two illustration conditions there was no significant difference. Nor was there a significant difference between the instructions-to-visualize condition and the other non-illustration condition.

The interactions between treatment conditions and level of illustration-dependence suggest that subjects given texts whose illustration-dependence was moderate to high benefited from the presence of illustrations. For those subjects, significantly more information was observed in their recalls of transfer texts if the related text preceding it had been illustrated; moreover, those subjects generated a significantly greater proportion of reader-based information in their recall of transfer passages. Interpreted in light of Kintsch and van Dijk's (1978) notion that proportion of inferential recall is directly related to integration of information and reflects the degree of reading engagement with text, the data suggest that illustrations induce knowledge integration and engagement with the text, if the text is highly dependent upon illustrations to deliver its message.

Although instructions to attend to text illustrations did appear to somewhat enhance performance on transfer tasks, improvement in

performance was not significantly improved by such instruction, except in the case of the most illustration-dependent text. Nor, in the absence of illustrations, did instructions to visualize the content significantly improved recall of the transfer passages. That no significant difference was observed between subjects' performance on the first no-illustration condition and the final no-illustration condition would seem to diminish the possibility that the results were due to an order effect.

The results of the present investigation are significant in that they contribute to a clearer understanding of the conditions under which illustrations in text play a facilitative role in prose learning. The data indicate that provision of illustrations enhances learning from text, but it does so to the extent that the text is illustration-dependent. This finding is significant in light of previous researchers' failure to detect illustrations' effect on children's learning from text. It confirms classroom teachers' everyday observations and commonsense conviction that informative illustrations in text help children comprehend and learn from printed language.

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Table 1
Means and Standard Deviations
of Information Units Recalled

Illustration Dependence	Treatment: No Instructions, No Pix	No Instructions, Pix	Instructions, Pix	Instructions, No Pix	Total
High					
$\bar{X}$	10.63	16.22**	17.81**	12.15	14.20
SD	5.65	6.47	6.54	8.65	6.83
Moderate					
$\bar{X}$	11.63	15.37	17.00*	14.19	14.55
SD	5.80	8.58	8.08	8.15	7.65
Low					
$\bar{X}$	14.67	15.52	16.48	14.85	15.38
SD	8.89	7.22	6.59	5.61	7.08
Independent					
$\bar{X}$	16.07	16.19	15.96	17.31	16.38
SD	7.34	6.82	6.34	6.54	6.76
Total	13.25	15.83*	16.81*	14.63	
	6.92	7.27	6.89	7.32	

ANOVA Summary for Information Units Recalled

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Between S				
Text	3	325	108.33	.57
Residual	104	1687	189.30	
Within S				
Trtmt	3	944	314.67	14.54***
Trtmt X Txt	9	711	79.00	3.65**
Residual	312	6752	21.64	
Total	431	28419		

*p < .05
**p < .01
***p < .001

Table 2
Means and Standard Deviations of Proportion of Inferences per Information Units Recalled

Illustration Dependence	Treatment				
	No Instructions		Instructions		
	No Pix	Pix	Pix	No Pix	Total
High					
$\bar{X}$	.29	.41**	.57**	.32	.40
SD	.22	.32	.27	.31	.28
Moderate					
$\bar{X}$	.38	.35	.32	.33	.35
SD	.23	.24	.29	.18	.24
Low					
$\bar{X}$	.19	.18	.12	.12	.15*
SD	.16	.16	.10	.11	.13
Independent					
$\bar{X}$	.37	.33	.23	.29	.31
SD	.18	.18	.15	.15	.17
Total	.31	.32	.31	.26	
SD	.20	.23	.20	.19	

ANOVA Summary Per Proportion of Inferences per Information Units Recalled

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Between S				
Text	3	13430	4476.67	2.95*
Residual	104	157772	1517.04	
Wintin S				
Trtmt	3	6212	2070.67	11.30***
Trtmt x Txt	9	4970	552.22	3.01**
Residual	312	57198	182.32	
Total	431	288502		

* $p < .05$
** $p < .01$
*** $p < .001$

Transfer Passage

The method of multiplying by nine on the fingers is easy if you remember which number each finger represents. Bend the finger you wish to multiply times nine. The number of fingers to the left of the bent finger is the number of tens in the product. The number of fingers to the right of the bent finger is the numberof units in the product. To find the product 3 X 9, bend the finger that represents 3. There are two fingers raised to the left of the bent finger and seven fingers raised to the right of the bent finger. The two fingers on the left of the bent finger represent the tens digit in the product. The seven fingers to the right of the bent finger represent the units digit in the product. Thus,

3 X 9 = 27.

Subject's Recall

If you want to find 3 X 9 you bend your 3rd finger on the left hand. To the left of this finger there are two other fingers so the first number would be 2. To the right of the third finger are 7 fingers so:

3 X 9 = 27

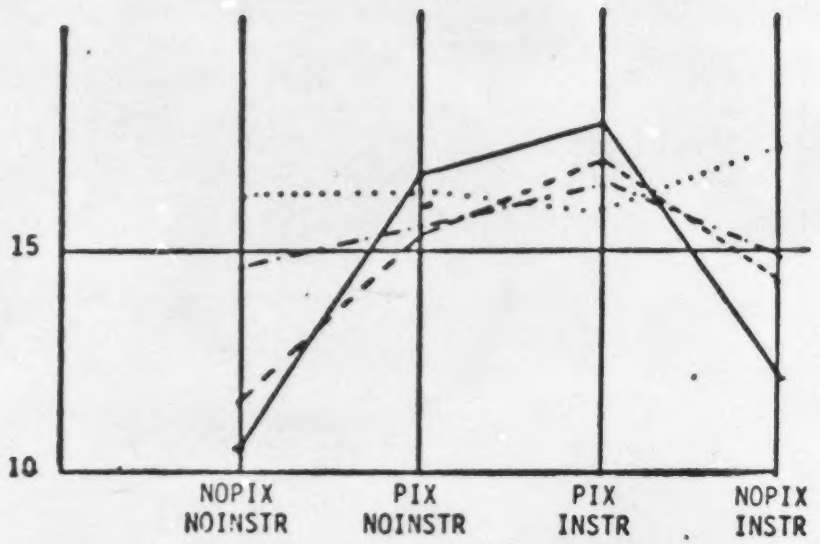
Propositions Reproduced from the Template Text Base

27. (CONDITION, TO, 30, 38)
11. (WISH, YOU, 12)
28. (FIND, $, 29)
30. (BEND, $, 31)
31. (QUALIFY, FINGER, 32)
32. (REPRESENT, 31, THREE)
37. (LOCATION, LEFT, 35, 38)
36. (QUANTITY, 35, TWO)
52. (LOCATION, RIGHT, 51, 53)
51. (QUANTITY, FINGERS, SEVEN)
56. (CONCESSION, THUS, 49, 55, 57)
57. (CONTRAST, EQUALS, 58, TWENTY-SEVEN)
58. (MULTIPLY, THREE, NINE)

Inferential Propositions Generated by the Reader

A. (PART, 32, B)
B. (QUALIFY, HAND, LEFT)
C. (REFERENT, THIS, 32)
D. (QUALIFY, FINGERS, OTHER)
E. (CONCESSION: SO, 36, F)
F. (IS A, TWO, G)
G. (QUALIFY, NUMBER, FIRST)

Figure 1. Scoring of a sample protocol.



····· No illustration-dependence
·—·—· Low illustration-dependence
– – – – Moderate illustration-dependence
——— High illustration-dependence

Figure 2. Mean number of propositions in recall per treatment condition.

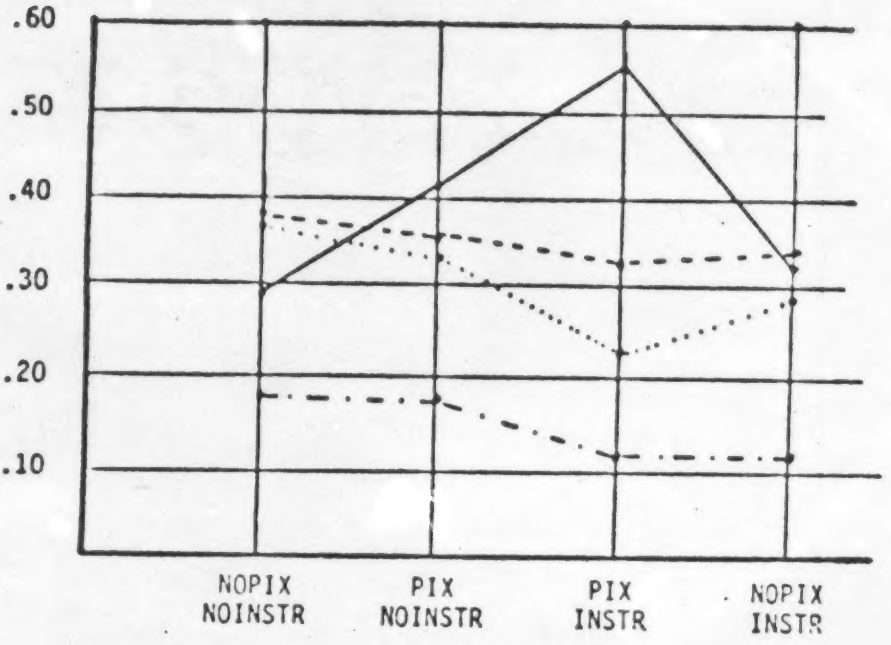


Figure 3. Mean proportion of reader-based propositions per treatment condition.